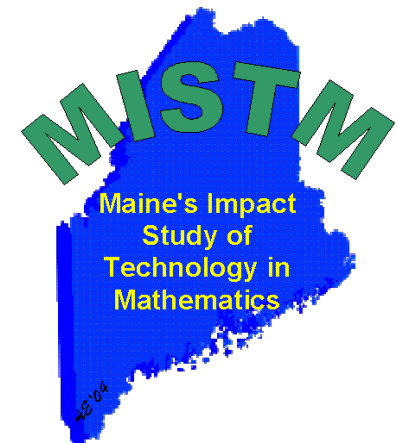


Maine's Impact Study of Technology in Mathematics (MISTM)

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Funded by the U.S. Department of Education
Office of elementary Secondary Education
School support and Technology Program
(#5318A03005)



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Maine's Challenge

- 79% of eighth grade students failed to meet state mathematic learning standards in 2002.
- 85% of low performing schools in mathematics are in rural communities.
- Over 50% of middle school teachers had limited mathematics content knowledge because they were trained as elementary school teachers.
- Only 61% of seventh and eighth grade mathematics teachers report using laptops in their instruction.



Maine Learning Technology Initiative

The Maine Learning Technology Initiative (MLTI) has provided all 7th and 8th grade students and their teachers with laptop computers, and provided schools and teachers technical assistance and professional development for integrating laptop technology into their curriculum and instruction.



Research Question

Can middle school mathematics test scores be improved by providing high quality, technology-infused professional development to middle school mathematics teachers in rural districts?

Maine's Impact Study of Technology in Mathematics (MISTM)

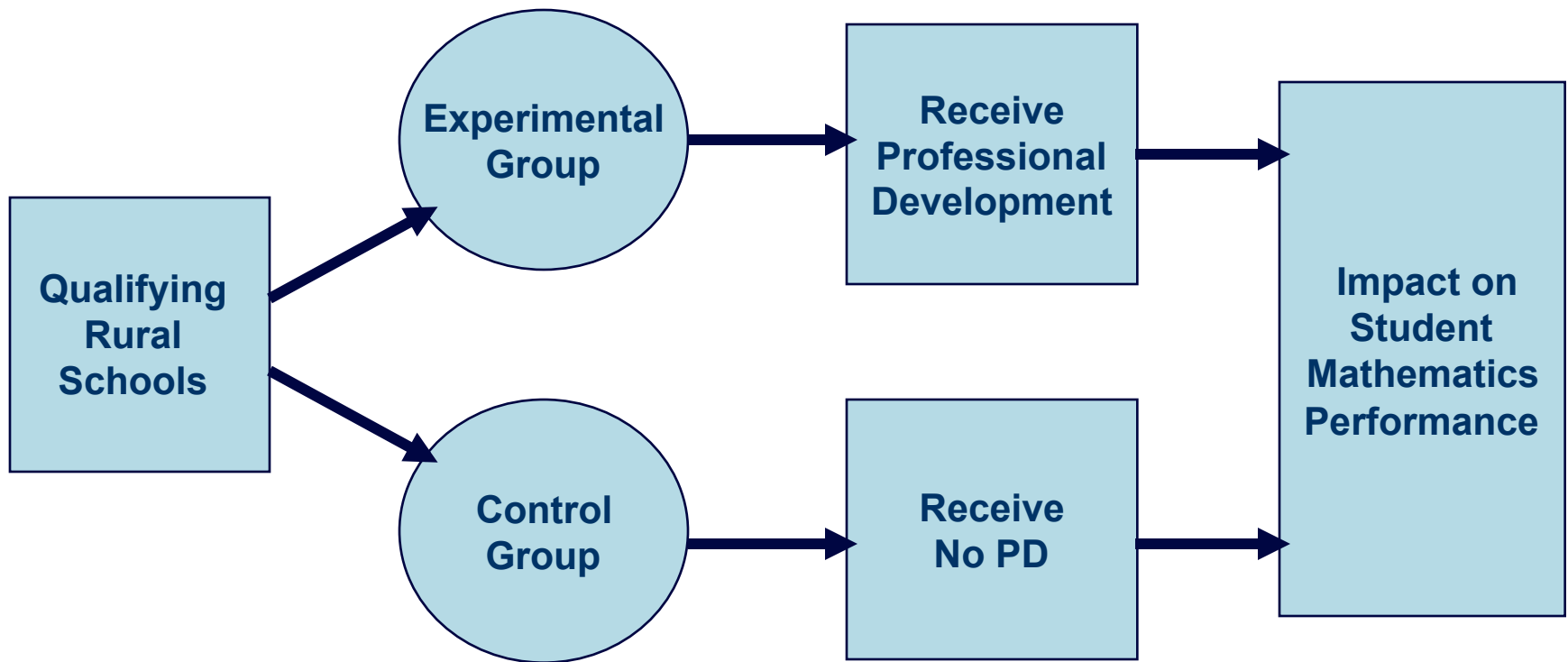
➤ **Partners:**

- Maine Department of Education
- Maine Education Policy Research Institute
- Education Development Center

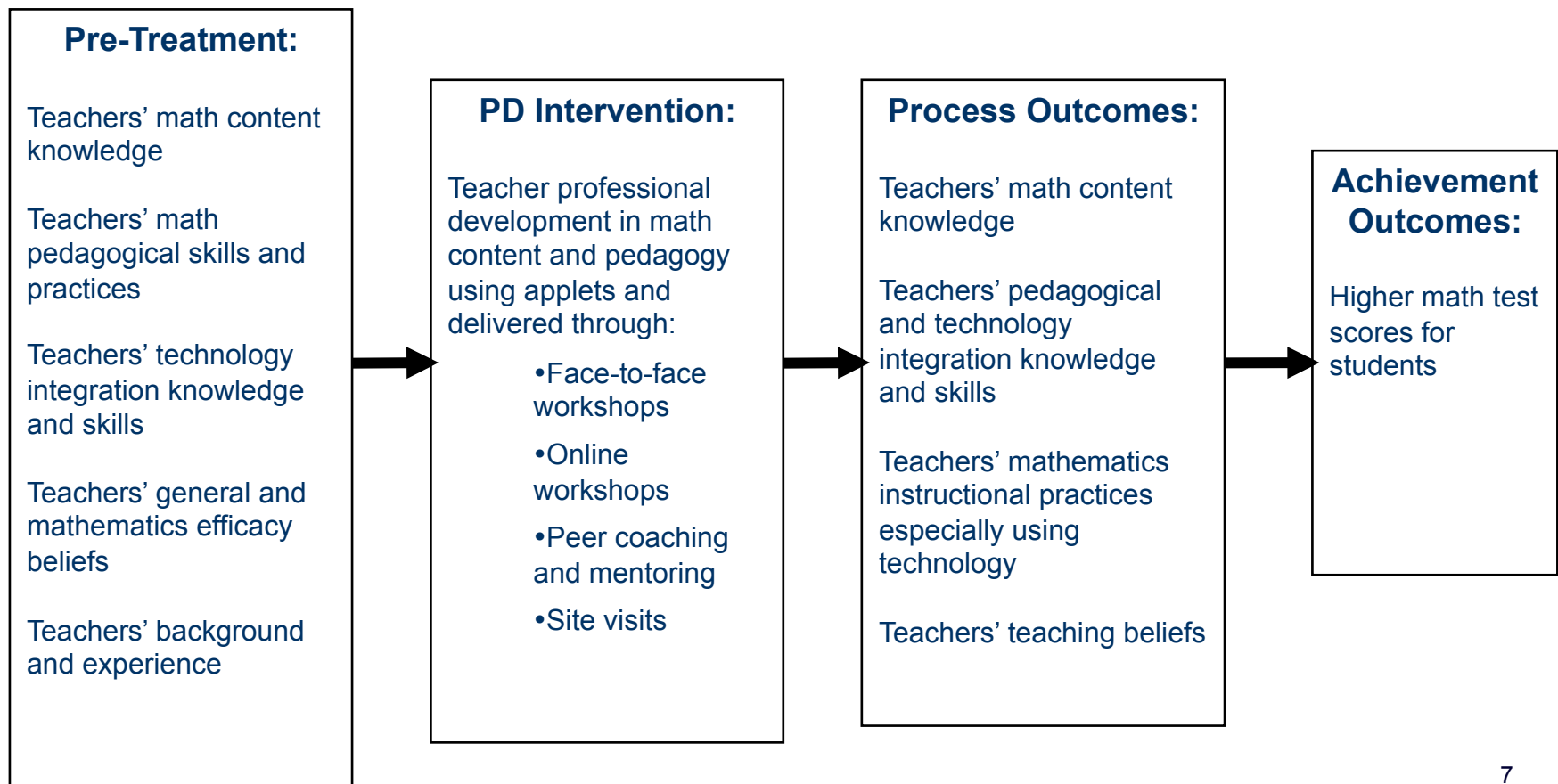
➤ **Grant Funded by the U.S. Department of Education**

- Office of Elementary and Secondary Education
- School Support and Technology Program
- (#5318A030005)

Randomized Control Group Design



Logic Model for MISTM Research





Sample

- **Participation Criteria: To qualify schools must have**
 - Served rural communities
 - Contained 7th and 8th graders in same building
 - Scored below state average in mathematics on state test for most recent 2 years
 - At least 40% of students eligible for free or reduced lunch programs
- **191 Schools qualified: 56 schools volunteered**
 - 57 experimental and 54 control teachers
 - Approx. 2,600 students in each group
- **All grade 7 and 8 teacher who taught mathematics in the school had to agree to participate :**
 - Participate in PD if assigned to experimental group
 - Complete all data collection activities



Mathematics Content Knowledge and Skills

Target Areas of Maine Learning Results

- *A1 – Numbers and Operations, which includes Numbers and Number Sense, and Computation.*
- *G1/K2 – Patterns, which includes patterns, relations & functions, algebra concepts, and mathematical communication.*



Professional Development Intervention

- **Content Knowledge**
 - Deepen teacher content knowledge
- **Pedagogy**
 - Improve teacher pedagogical practice in technology infused mathematics classrooms
- **Technology Integration**
 - Develop and apply strategies that support the integration of technology for the teaching, learning and assessment of mathematics
- **Professional Learning Community**
 - Engage teachers in meaningful interaction and dialogue about mathematics through face-to-face and online environments
- **A multi-faceted two-year program which included:**
 - Face-to-Face Activities (60 hours)
 - Online Learning Component (100 hours)
 - Peer Coaching/Staff Mentoring/Site Visits (48 hours)
 - 208 hours total over two years



Student & Teacher Assessment Measures

Assessment Development

- Teacher and student assessments used in MISTM were developed by mathematics specialists at the Maine Department of Education and researchers at the Education Development Center.
 - Three different versions of each test were developed, field tested and analyzed for validity and reliability characteristics
 - Test items checked for difficulty, discrimination and bias

Teacher Assessments

- Teachers were provided with examples of student work and asked to indicate what, if anything, was wrong with the students' thinking or understanding of the problem.



Analysis Procedures – Three Phases

- Standard analysis of variance techniques to examine total group post test performance.
- Hierarchical linear modeling (HLM) to model differences in achievement between the experimental and control groups.
- Path analysis to examine the impacts of the intervention on teachers' knowledge, beliefs and practices and student achievement.

Results: Phase I: Total Group Performance

Student Total Mathematics Test Score Results After Two Year Intervention

| Content | | Experimental (n=281) | Control (n=692) | t= | p= | Effect Size |
|---|-------------|-------------------------|--------------------|------|-------|----------------|
| Mathematics Test Total Score | Fall 2004 | 32.1% | 27.8% | 3.80 | <.01 | 0.29 |
| | Spring 2005 | 54.6% | 47.9% | 3.62 | <.01* | 0.39 |

*ANCOVA : T-test for group effects.

Student Mathematics Subtest Score Results After Two Year Intervention

| Content | | Experimental (n=281) | Control (n=692) | t= | p= | Effect Size |
|----------------------|-------------|-------------------------|--------------------|------|-------|----------------|
| A1 Subtest | Fall 2004 | 30.1% | 25.8% | 3.87 | <.01 | 0.28 |
| | Spring 2006 | 56.0% | 51.5% | 0.35 | >.01* | 0.22 |
| G1/K2 Subtest | Fall 2004 | 35.4% | 31.2% | 3.30 | <.01 | 0.24 |
| | Spring 2006 | 53.4% | 44.8% | 5.97 | <.01* | 0.50 |

*ANCOVA: T-test for group effects.

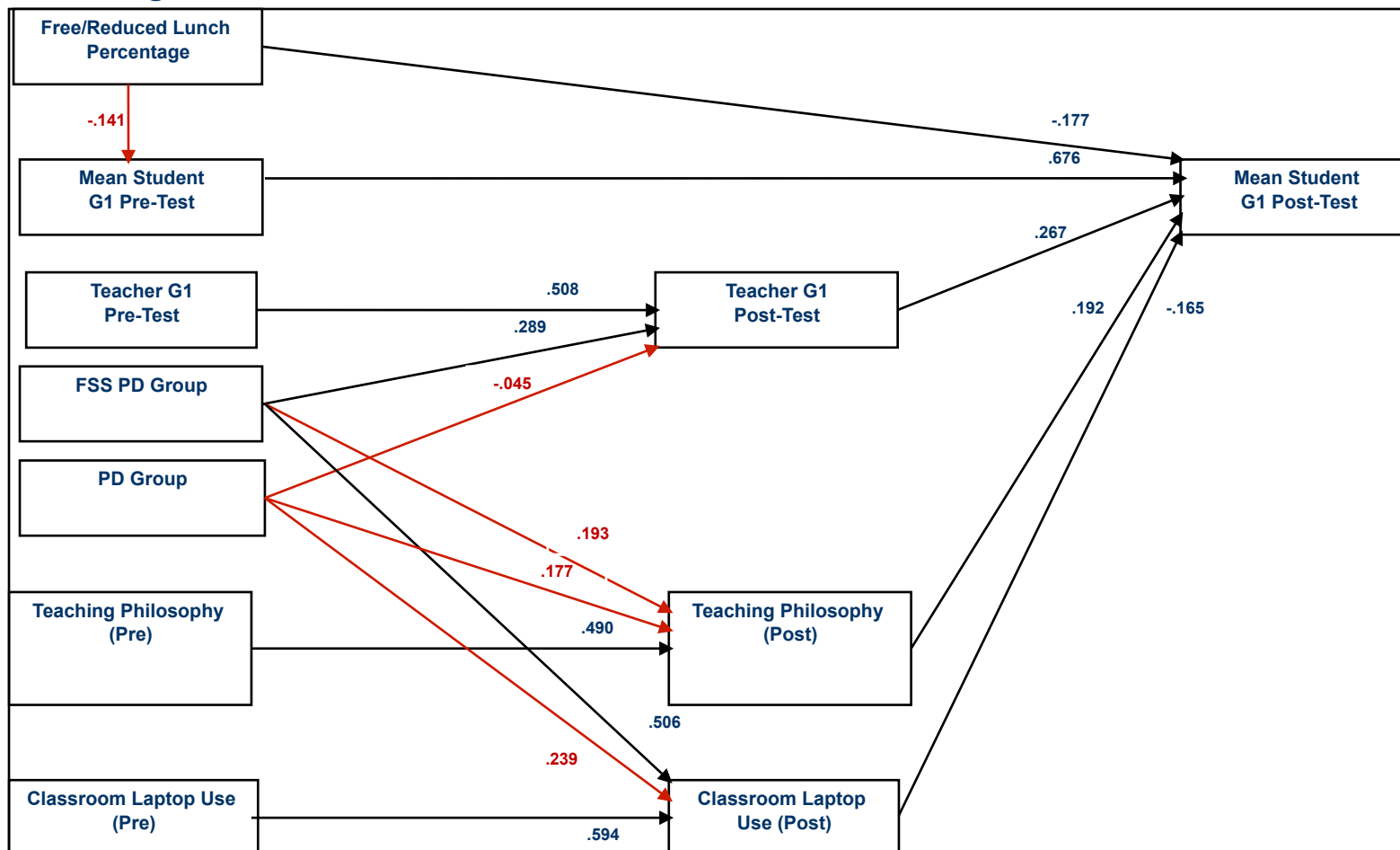
Phase II: HLM Analysis

Total Mathematics Test Scores Two-Year Two-Level Analysis

| Outcome = Student Score (A1 & G1) | | | Model 1 | | Model 2 | | Model 3 | | | | Model 4 | |
|--|----------------|------------------|-------------------|--------------------|-------------------|--------------------|-------------------|-------------------------------------|---------------------------------|-------------------|--------------------|-------|
| | | | Coeff. | Sig. | Coeff. | Sig. | Coeff. | Sig. | | | Coeff. | Sig. |
| Student Level Predictor (n=1,456) | | | | | | | | Student Level Predictor | | | | |
| Fall 04 Student Assessment | | | 0.816018 | 0.000 | 0.816018 | 0.000 | 0.816018 | 0.000 | Fall 04 Student Assessment | | 0.816018 | 0.000 |
| Teacher and School Level Predictors (n=51) | | | | | | | | Teacher and School Level Predictors | | | | |
| (intercept) | | | 0.491784 | 0.000 | 0.490815 | 0.000 | 0.490973 | 0.000 | (intercept) | | 0.491037 | 0.000 |
| Mean Fall 04 Student Assessment | | | 0.932184 | 0.000 | 0.856281 | 0.000 | 0.853572 | 0.000 | Mean Fall 04 Student Assessment | | 0.859571 | 0.000 |
| Fall 04 Teacher Assessment | | | | | 0.150415 | 0.109 | 0.159063 | 0.105 | Spring 06 Teacher Assessment | | 0.137999 | 0.047 |
| NSLP (School) | | | | | -0.000684 | 0.125 | -0.000683 | 0.138 | NSLP (School) | | -0.000504 | 0.254 |
| Teaching Philosophy (Pre) | | | | | 0.004984 | 0.564 | 0.004225 | 0.645 | Teaching Philosophy (Post) | | 0.011709 | 0.125 |
| Laptop Use (Pre) | | | | | 0.006900 | 0.879 | 0.001110 | 0.814 | Laptop Use (Post) | | -0.003734 | 0.279 |
| Conceptual Use (Pre) | | | | | -0.008915 | 0.362 | -0.009449 | 0.361 | Use of Applets (Post) | | -0.001221 | 0.874 |
| Strictest Treatment Group | | | | | | | 0.003849 | 0.846 | Strictest Treatment Group | | | |
| Treatment Group, Not Strictest | | | | | | | 0.007712 | 0.679 | | | | |
| Variance Component | No Predictors | | Model 1 | | Model 2 | | Model 3 | | Variance Component | Model 4 | | |
| | Total Variance | Percent of Total | Residual Variance | Variance Explained | Residual Variance | Variance Explained | Residual Variance | Variance Explained | | Residual Variance | Variance Explained | |
| Between Teacher | 0.00969 | 28.4% | 0.00164 | 83.1% | 0.00155 | 84.0% | 0.00163 | 83.2% | Between Teacher | 0.00139 | 85.7% | |
| Within Teacher | 0.02440 | 71.6% | 0.01293 | 47.0% | 0.01291 | 47.1% | 0.01292 | 47.0% | Within Teacher | 0.01292 | 47.0% | |
| Total | 0.03409 | 100.0% | 0.01457 | 57.3% | 0.01446 | 57.6% | 0.01455 | 57.3% | Total | 0.01431 | 58.0% | |

Phase III: Causal Modeling

Path Diagram for G1/K2 Subtest Scores





Results Summary

Research Question: Can middle school mathematics test scores be improved by providing high quality, technology-infused professional development to middle school mathematics teachers in rural districts?

Answer: Qualified “yes”



Results Summary

- When teachers actively participated in the PD intervention activities for two years, their content knowledge increased as did their use of laptops in teaching mathematics. But that did not consistently translate into increased student learning.
- Student knowledge of mathematics patterns and relationships did increase (G1/K2), but knowledge of numbers and operations (A1) did not.



Why didn't we see more dramatic results?

Possible Reasons:

- Substantial treatment non-compliance
- Timing issues between instruction received by students and assessments completed
- A1 taught primarily in 7th grade and G1/K2 in 8th
- Length of study (not long enough to measure impact on student learning)



Implementation of the RCT Design

Some of the Challenges of Conducting Scientifically Based Experimental Field Trials:

Potential Impacts on Design and Results:

- Sample:
 - Selection and assignment.
 - Losses in longitudinal sample.
- Intervention:
 - Varying levels of commitment.
 - Implementations in varying settings.
- Data Collection:
 - Reliance on self-reporting data.
 - Loss or incomplete data points.
- Analysis:
 - Unit of analysis.



Summary Observation: Balancing Classic Experimental Design with the Realities of Schools

“Can high-quality research take place in schools?
Absolutely. Can such research inform best practices and
guide educational policy? Certainly. Can this research, in
all cases, reflect the types of medical models that inform
the new federal guidelines for educational inquiry?
Probably not.”

Overbay, A.S., Grable, L.L., Vasra, E.S. (2006). “Evidence-based education: Postcards from the edge.” Journal of Technology and Teacher Education, 14(3), 623-632.



For Additional Information

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